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USSR CONFERENCE ON THE PROBLEM OF NONCELLULAR FORMS OF LIFE

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From 5 to 7 May the Department of Biological Sciences of the Academy of Sciences USSR and the Academy of Medical Sciences USSR held a conference devoted to the results and prospects of research on noncellular forms of living matter.

The first conference on this subject organized by the Department of Biological Sciences and by the Academy of Medical Sciences USSR took place in 1950. Experimental data arrived at by Prof O. B. Lepeshinskaya and her collaborators, which were documented and widely discussed at this conference, proved that cells may originate not only from cells by means of division, but may also under certain conditions develop out of living matter of noncellular structure. These findings have struck a crushing blow to the idealistic teachings of Virchow, which have prevailed in biology and medicine for almost 100 years. The 1950 conference was an important milestone in the development of the progressive study of noncellular forms of life and the fight against the reactionary theories of Virchow. These theories have served as a basis for Mendelism-Morganism and have contributed to the development of the racist theories advanced by imperialists.

At a conference held in 1952, in which educational institutions and scientific research institutions of the Ministry of Public Health of the USSR participated, the first results of research on the growth and development of living matter were summarized.

The 1953 conference constituted the next step in the development of our progressive Soviet science concerning noncellular forms of life. Five hundred people, among them 60 from other cities, participated in the conference. Reports were given by Prof O. B. Lepeshinskaya, Active Member of the Academy of Medical Sciences USSR; V. G. Kryukov, Scientific Associate of the Institute of Experimental Biology of the Academy of Medical Sciences USSR; G. K. Khrushov, A. N. Studitskiy, and F. I. Khaletskaya, Doctors of Biological Sciences; A. A. Imshenetskiy, Corresponding Member of the Academy of Sciences USSR; Prof I. I. Mayskiy; V. D. Timakov, Active Member of the Academy of Medical Sciences USSR; V. L. Ryzhov, Corresponding Member of the Academy of Sciences USSR; N. M. Sisa-kyan, Doctor of Biological Sciences; A. L. Kursanov, Corresponding Member of the Academy of Sciences; and Prof V. N. Orekhovich.

Many scientists from other cities participated in the discussion of the various problems touched upon in the papers, particularly Professors M. P. Gnutenko (Saratov University), V. G. Yeliseyev (Omsk Medical Institute), D. F. Petrov (Stalingrad Medical Institute), Z. S. Katsnel'son (Leningrad Veterinary Institute), G. P. Kalina (Chernovtsky Medical Institute), and others.

The numerous reports as well as the abundance of written comments received by the speakers attest to the fact that the conference enjoyed the very active participation of its membership consisting of biologists active in the most diverse specialities in various parts of the country.

O. B. Lepeshinskaya described the successes of new investigations in the field of noncellular forms of life in her paper, "The Theory of the Development of Living Matter, Its Achievements and Prospects." She pointed out that more and more articles of a theoretical and practical nature, which deal with biological processes on the basis of the progressive theory of living matter, are appearing

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in scientific literature. At the same time some scientists, who formally acknowledge the theses of this theory, actually conceive the development of the cell metaphysically, i.e., based on merely quantitative changes. In some cases living matter is regarded as being simply the product of the destruction of cells. O. B. Lepeshinskaya emphasized that it is not just any product of the disintegration of cells which serves as the material for new cells, but only the viable living matter which is endowed with the property of metabolism.

A number of reports read at the conference touched in one way or another upon the general problems of the formation and development of living matter, its role and changes.

In his paper, "The Plastic and Conservative Properties of Living Matter in the Process of its Development," V. G. Kryukov attempted to establish a basis for a law governing the formation and development of noncellular living matter. According to this speaker's view, molecules of disconnected plastic matter are devoid of inherent mutual opposition and therefore cannot be living. He regards the beginning of ontogenesis as a transition process of the transformation of viable matter into living matter, similar to the process by which primary living matter came into being.

It must be noted that the theses advanced by V. G. Kryukov need further elaboration and experimental proof.

The paper of N. N. Zhukov-Verezhnikov, I. N. Mayskiy, and L. S. Kalinichenko, "Species and Species Formation in Microbiology," generalized the results of work by Soviet microbiologists on the problem of species formation from the standpoint of the doctrine of living matter.

The paper showed that a careful immunological analysis gives evidence that a radical change in the living conditions of bacteria causes a complete reconstitution of its type of metabolism. According to the authors of the paper, this reconstitution is connected with the formation and accumulation of living matter. Living matter characteristic of the old species is still preserved in individuals of the new species, but that which characterizes the new species is precisely the new living matter. This matter is composed of proteins with new chemical properties. These new properties are hereditarily unalterable.

V. L. Ryzhkov's paper, "Crystals and Life," gave a similar treatment to the problem. The speaker remarked that neither the heterogeneity of protoplasm nor the instability of its structure prevents the formation of a crystalline or paracrystalline arrangement which plays an important role in the very complex processes of development and morpho-differentiation. It is also very probable that crystalline structures play a role in the origination of life itself, and in the development of primary living organisms.

The participants at the conference showed great interest in reports on experimental research, particularly research devoted to the clarification of the role of noncellular living matter in processes leading to the normal and pathological formation of new cells and tissues.

In his paper, "The Formation of Ova from the Structureless Matter of Ovary Tissue Induced by Cultivating This Matter in Subcutaneous Connective Tissue," G. K. Khrushchov presented the results of research which he carried out in cooperation with A. V. Abuladze.

This research determined that one of the factors contributing to the formation of an ovum in transplanted ovaries is the temporal coincidence of two processes: the degeneration of ova and the appearance of blood vessels. A necessary prerequisite for the formation of ova on implantation is the preservation of the properties of the ovaries as living matter even after the ovary tissue has been destroyed.

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The first results of work on the neoformation of ova from substances transported to the site by the blood and serving as material in the regenerating ovaries of mammals furnish experimental proof of the falseness of the Weismannist notion on the uninterruptedness of the so-called embryonic path, and offer the possibility of an analysis of the minute processes which underlie the inheritance of acquired characteristics.

In his paper, "Types of Development of Living Matter in Regenerative Processes," A. N. Studitskiy focused his attention mainly on the laws and motivating forces leading to the formation of cells in the process of the regeneration in higher vertebrates of healthy muscles from crushed muscle tissues. By developing living matter in response to a lesion, an organism ensures the regeneration of a model, as the speaker expressed it, of the lost organ even from another type of tissue. Thus, crushed smooth muscle tissue transplanted to replace skeletal muscle becomes a source for the development of living matter from which a smooth-muscle model of the cross-striped muscle is constructed.

The methods of inducing neoformation of the nuclei of muscle fibers, as disclosed by the speaker, permit a broadening of existing views on the neoformation of cellular structures.

Further substantiation was given to phenomena of neoformation of tumor cells and tissues from noncellular material in the paper read by F. I. Khaletskaya, "The Role of Noncellular Forms of Living Matter in Tumor Growth." It has been determined that under favorable environmental conditions, noncellular living matter in a tumor fiber may become the source of tumor cells capable of metastasizing into inner organs.

A number of papers and numerous discussions touched upon problems which are still controversial, such as the nature of the origin of filterable forms, the connection between filterable forms of bacteria and pathogenic viruses and bacteria, the metabolism of viruses and phagi, the biological mechanism of their reproduction, the role of noncellular living matter in the processes of species formation, etc.

In his paper, "The Filterable Forms of Bacteria," A. A. Imshenetskiy observed that the problem of the noncellular forms of life of microorganisms touches upon a number of questions of general principle, such as the limits and origin of life, the concept of the cell, and the precellular period of evolution. This problem, however, is still in the stage of intensive experimental study. Therefore, at the present time, in the field of study of the filterable forms of microorganisms, a critical approach to applied methods and a careful analysis of data obtained by various laboratories are of the greatest importance. In particular, the speaker warned against the application of the method of feeders [mentors] and expressed his view on the possibility of the presence of filterable forms of bacteria in the air.

In the opinion of A. A. Imshenetskiy, it is entirely possible that noncellular forms enter into the life cycle of bacteria as one of its stages. Sufficiently reliable data on this problem, however, do not exist as yet.

The problem of the nature of filterable forms of bacteria was also the central theme of V. D. Timakov's paper, "The Role of Living Matter in the Development of Microorganisms." The speaker insisted with full justification that filterable forms of microorganisms and filterable viruses are not "organisms of the same order" as G. M. Bosh'yan assumes, but formative products of different origin with an evolutionary pattern of their own. "Michurinist biology," V. D. Timakov stated, "having insisted on the thesis of the possibility of the transformation of one species into another, and of the capacity of one species to give birth to others,

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at the same time acknowledges the actual existence of species as qualitatively distinct units of living nature, and does not obliterate all the limits of qualitative differences and dissimilarity of the organic forms of movement and development in nature."

V. D. Timakov considers filterable forms of bacteria to be noncellular forms of living matter which arise as a result of the influence of unfavorable factors of the external environment on [cellular] microorganisms.

Under certain circumstances cellular structures with the specific characteristics of the initial living matter are developed or regenerated from the noncellular matter.

Prof G. P. Kalina in his contribution to the discussions supported the opinion that the filterable form constitutes a stage of the normal ontogenesis of bacteria.

Academician T. D. Lysenko also dwelt on this problem. In his speech Lysenko emphasized the importance of the study of species formation on microbiological material and at the same time expressed the opinion that the filterable forms of bacteria must not be regarded as a stage of development.

Although the problem of the nature and basic properties of filterable forms of bacteria was one of the main subjects at the conference, the opposed views of the participants could not be reconciled sufficiently to permit them to reach a unified conclusion. As a result of the exchange of opinions it became evident that it would be necessary to carry out further investigations, applying new methods, in order to formulate a theory explaining the formation and development of filterable forms of bacteria.

The reports of N. M. Sisakyan on "The Metabolism of the Cavity Fluid in the Process of Metamorphosis of the Mulberry Silkworm" and of A. L. Kursanov on "The Respiratory Function of the Cavity Fluid of the Mulberry Silkworm in the Process of Metamorphosis" were devoted to an investigation of biochemical reactions which take place in noncellular living matter during its development, including reactions of both disintegration and neoformation.

In view of the fact that under living matter one understands structures which have a capacity for development and for biological metabolism, the importance of research in the field of the biochemistry of living matter is fully evident. As a result of research conducted by N. M. Sisakyan and Ye. B. Kuvayeva, the biosynthesis of proteins without the participation of cellular structures has been completed. The connection between this process and the energy reactions of metabolism has been shown by A. L. Kursanov and E. I. Vyskrebentsova. These investigators also showed in their paper that living matter devoid of cellular structures is functionally capable of coordinated respiration and other important features of metabolism which characterize the activity of ordinary cells.

The problem of the intermittence of metabolism touched upon in A. A. Imshenetskiy's paper and in the discussions is of serious theoretical significance. Contemporary science sets forth a series of persuasive facts which indicate that living matter may remain in an inactive state for protracted periods of time at certain stages in its development and under certain conditions. The posing of the question in regard to the possibility of a development of living matter in discrete stages separated in time must unquestionably be regarded as an achievement of the conference.

V. N. Orekhovich's paper, "Some Experimental Data on the Processes of Transformation and Synthesis of Proteins in Living Matter," discussed the results of investigations of the chemical composition and structure of living matter. The research undertaken by V. N. Orekhovich with the use of the method of tracer

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atoms, in addition to a number of other methods, proves the possibility of the synthesis of proteins in living matter, in particular the synthesis of the enzyme amylase. This research must be further developed and particular attention must be devoted to the study of the mechanism of the synthesis of proteins in living matter.

The author's thesis that not all protein systems outside an organism have the ability to synthesize proteins must be regarded as completely reasonable. Therefore the assumptions of a number of investigators who on the basis of careless experiments, draw far-reaching conclusions regarding the living nature of molecules of individual proteins, cannot withstand criticism.

Prof S. Ya. Kaplanskiy, who spoke in reference to V. N. Orekhovich's paper, correctly recommended a certain caution in the application of the method of tracer atoms and a critical evaluation of its results.

It must be emphasized that the majority of papers and speeches at the conference were founded on concrete experimental data rather than on assumptions. The discussions were businesslike and rested on factual material.

The conference formulated the concrete tasks which confront the various biological disciplines regarding the further treatment of the problem of non-cellular forms of life.

Thus in the fields of histology and embryology it was pointed out that it would be necessary to further extend work on the investigation of the processes involved in the neoformation of cells and various cellular structures from non-cellular matter both in mature and in developing organisms, and under normal as well as pathological conditions.

The conference noted the completely inadequate coordination between work in cytology and histology on the one hand, and corresponding biochemical, physiological, and genetic experimental investigations on the other. It recommended the formulation of detailed plans for working on concrete problems involved in the neoformation of cells and tissues from noncellular living matter.

In the field of microbiology and virology, a further many-sided study of the conditions, morphological aspects, mutability, and modes of biochemical reproduction of viruses and phagi in the bodies of their host-organisms, together with a clarification of the nature of crystalline viruses and phagi, was acknowledged as particularly urgent.

A resolution of the conference stated that it would be necessary (1) to study more extensively and thoroughly the groups of ultra-microbes, particularly of the free-living ones; (2) to clarify the biological significance of noncellular forms of bacteria; (3) to undertake electronmicroscopic investigation of the filterable forms; (4) to clarify the physiological conditions of their development into bacterial cells; (5) to elucidate the role of noncellular forms of life in the processes of mutation and species formation of microorganisms; and (6) to study the connection between pathogenic or phytopathogenic viruses and the microorganisms which accompany them.

In the future, the task will arise of investigating the possibility of the autogenesis of noncellular living matter from nonliving matter in a natural environment and in the contemporary period.

In the field of biochemistry the conference urged that research be extended in the field of metabolism of noncellular forms of living matter and that this work be coordinated with the corresponding investigations carried on in related fields of knowledge, particularly physiology and histology.

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The study of the laws governing the metabolism of noncellular forms of life, particularly of the laws governing the formation of proteins and their mutation into complex biochemical systems which are functionally capable of self-regeneration and coordinated, regular metabolism, the study of the changes in living matter which occur in the organism during growth, and the elaboration of the problem of the discontinuity of metabolism were considered as objectives of primary importance.

The conference noted in particular that the oversimplified ideas concerning the nature and conditions of the self-regeneration of proteins and the ideas concerning the living nature of various individual protein molecules, which have found favor in some biochemical circles, may impede progress toward knowledge of the objective laws of life phenomena.

The conference's statement concerning the necessity of applying to the study of the various forms of life such research methods as the crystallographic, the electron microscopic, and the precise cytolytic-chemical and histological methods, among others, is of great significance for further fruitful development of a materialistic theory explaining the evolution and modification of noncellular forms of living matter.

Factual data collected in microbiology and virology confirm the existence of multifarious forms of life. It is beyond doubt that there also exist primitive organisms which stand on the border line between precellular and cellular forms of life, differentiated bacterial cells as yet lacking a structurally complete nucleus, myxobacterial cells with nuclei, and finally complex and highly differentiated cells of the infusoria and other protozoa.

The possibility of development of cells from noncellular living matter has been established. However, much still remains unexplained in this field and further experimental elaboration of the problem will be necessary in order to be able to reach any conclusions of general validity.

As Academician A. I. Oparin pointed out in his concluding remarks to the conference, we still stand only on the threshold of an extensive field of knowledge. Nevertheless, the path to a full mastery of the processes of life has been opened up by the daring and progressive investigations of Soviet scientists. There can be no doubt that, proceeding along this path, Soviet scientists will achieve new stupendous successes.

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